Climate Variability and Predictability Program (CVP)
Information Sheet FY 2010

Background

The Climate Variability and Predictability (CVP) program is a competitive research program that seeks to improve understanding of the causes and predictability of variations in the climate system. The program supports an array of diagnostic studies based on observational and model analysis that focuses on the fundamental patterns of climate variability including their coupling to boundary forcing. The time scales of interest range from multiannual-decadal and longer. CVP has the following scientific objectives:

- To improve our understanding of the causes of climate variability through modeling and diagnostic studies;
- To determine the observed characteristics, underlying mechanisms, and predictability of climate variations on multiannual and longer time scales, and
- To understand the mechanisms for abrupt climate change.

Motivation

Over the last several years there has been a growing recognition of the need to augment seasonal to interannual climate predictions and century-scale climate projections with decadal-scale climate predictions. The climate system is not changing in a simple linear fashion. Rather, climate system changes are a combination of natural climate variability and the response of the climate system to radiative forcing changes of both natural and anthropogenic origin. The interaction of natural variability and forced climate change has the potential to lead to abrupt climate change. In the recent U.S. Climate Change Science Program (CCSP) Synthesis and Assessment Product (SAP) 3.4 (http://www.climatescience.gov/Library/sap/sap3-4/final-report/), abrupt climate change is defined as *"a large-scale change in the climate system that takes place over a few decades or less, persists (or is anticipated to persist) for at least a few decades or more, and causes substantial disruptions in human and natural ecosystems."* Climate prediction on decadal scales requires the capability to predict both the natural variability of the climate system and its response to radiative forcing as well as the understanding of the potential sources of abrupt climate change.

There are prominent and important examples of this possible interplay between forced climate change and natural variability. As one example, there have been dramatic changes over the last decade in the characteristics of hurricane activity over the Atlantic, with associated impacts over North America. It is currently an unresolved issue whether these changing hurricane characteristics are due to human-induced climate change or are attributable to natural variability - or some combination thereof. The answer to this question has major implications for understanding the likely characteristics of future Atlantic hurricane activity. Similarly the last several years have seen significant drought over the western U.S. While drying in the southwestern U.S. is broadly consistent with model-based projections of the impact of global warming, it is an open question whether the current drought is a manifestation of forced climate change or natural variability. The answer to this question has major societal implications for large-scale water resources.

Another example is the Atlantic Meridional Overturning Circulation (AMOC). Since this circulation transports a substantial amount of heat from the Tropics to higher latitudes, fluctuations in this circulation can have a profound impact on climate. Previous work has linked AMOC changes to Indian and African monsoon rainfall, hurricanes in the Atlantic, and summertime temperature and rainfall over North America and Europe. It has also played an important role in past abrupt climate changes, such as those that occurred during the ending of the Last Ice Age approximately 8,000 to 13,000 years ago. The recent CCSP 3.4 report also examines the possibility of future abrupt change in the AMOC.

There are a number of significant research topics that must be addressed in order to develop a robust capability for decadal-scale climate predictions and an assessment of potential sources of abrupt climate change. While significant effort has gone into simulating the response of the climate system to radiative forcing changes on multi-decadal and longer time scales, less effort has gone into attempting to predict the evolution of the climate system on decadal scales or to simulate abrupt climate change. Among the important research topics to address are (a) What are the physical mechanisms responsible for observed decadal scale climate variations and (b) What processes have the potential to contribute to abrupt climate change? Increased understanding of these mechanisms is an important foundation for any predictive capability.

FY 2010 Priorities

Decadal Climate Predictability and Prediction

Modeling and diagnostic proposals with a focus on decadal variability, prediction and predictability are encouraged. Such studies may include, but are not limited to, those that seek to explore the interactions between decadal ocean variability and North American climate.

It is anticipated that the planned suites of decadal prediction and predictability experiments as part of CMIP5 will provide a new opportunity for significant advancements on this topic. This announcement especially encourages diagnostic studies using the results of the CMIP5 experiments leading to a better understanding of the sources and mechanisms for decadal predictability as well as the development of metrics for assessing decadal prediction quality and the fidelity of the climate simulations on decadal time scales. Additional decadal predictability and prediction modeling studies that build upon the CMIP5 experimental design (e.g., initialization, impact of observations, ensemble generation, impact of uncertainty in external forcing, isolating mechanisms of predictability, separating forced from natural variability) are also strongly encouraged.

The program seeks modeling and diagnostic proposals focusing on understanding the causes of climate variability over the modern observational record, and which attempt to quantify the relative roles of radiative forcing changes and natural variability for explaining the observed climate record. The use of multiple disparate observational records and novel modeling experiments is a plus. Proposals using the CMIP5 experiments for either developing new prediction products, or augmenting existing prediction efforts on different time scales are also encouraged.

AMOC

In collaboration with NSF and NASA, NOAA's CVP program is engaged in the interagency effort to develop the initial components of an experimental AMOC monitoring and prediction capability as detailed in the report *"Implementation Strategy for a JSOST Near-Term Priority: Assessing Meridional Overturning Circulation Variability – Implications for Rapid Climate Change"* (U.S. CLIVAR Report No. 2007-2, October 2007; http://www.atlanticmoc.org/index.php). The interagency plan is designed to take advantage of rapidly advancing observing and assimilation capabilities as well as leverage substantial international investment.

CVP encourages proposals that:

- Evaluate the predictability of AMOC through diagnostic and modeling studies, including hindcasts.
- Assess the impact of AMOC variations on terrestrial climate, especially with regard to any predictable component of AMOC variations.
- Identify mechanisms and forcing important for AMOC variability

Abrupt Climate Change

The program seeks modeling and diagnostic proposals focused on understanding the causes of abrupt climate change with identifiable linkages to decadal prediction and predictability research. Special emphasis will be given to proposals focusing on the possibility of abrupt change related to drought and the hydrologic cycle. Proposals evaluating the potential role of AMOC in abrupt climate change are also encouraged.

A potential new area for funding based on the FY10 President's Budget will be for proposals that aim to improve our ability to model glaciers and land-based ice sheets, including their role in future sea level rise. This work should contribute to NOAA's climate prediction mission.

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